

Requirements for EMMA RF Systems

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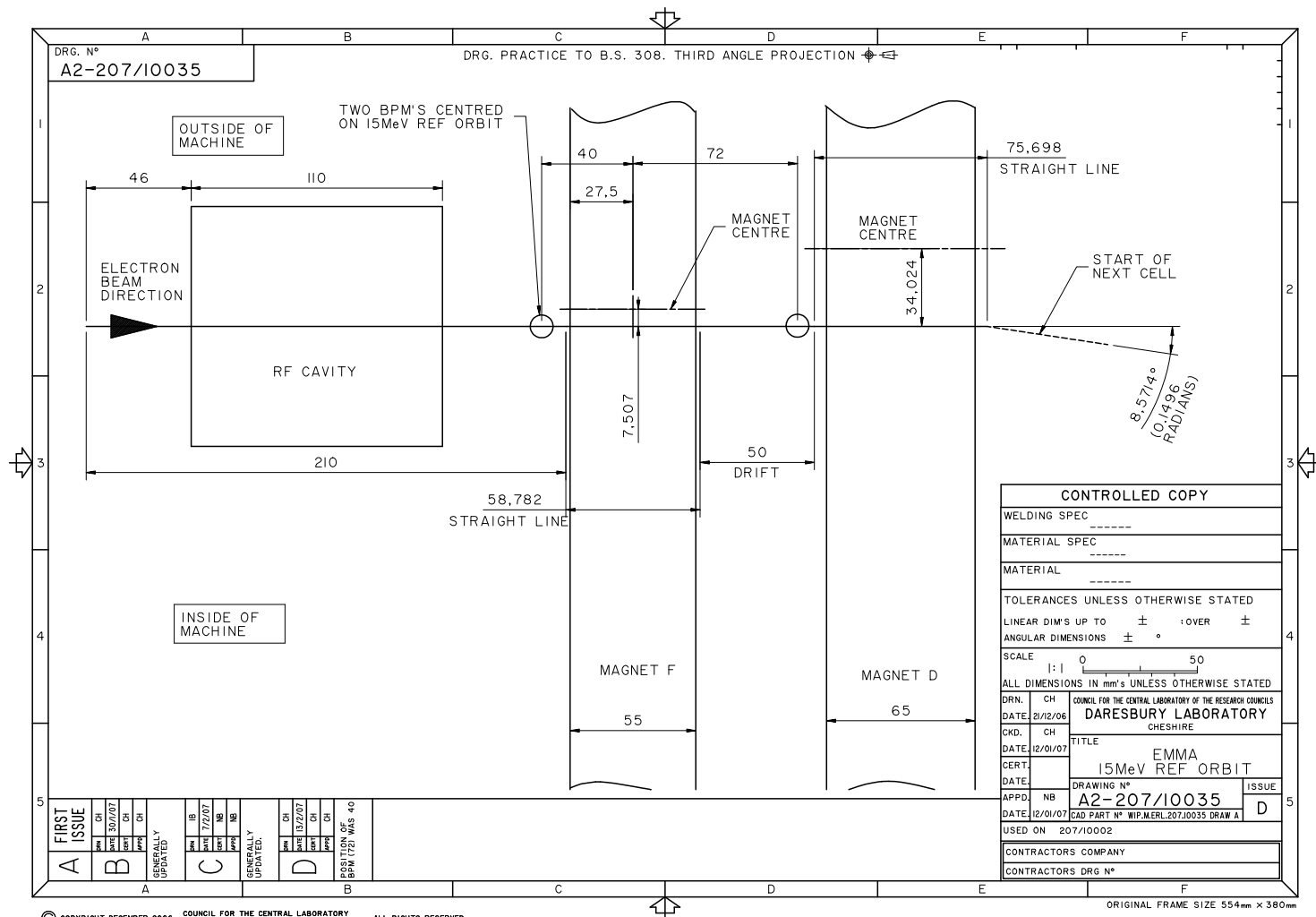
Outline

- Aperture
- Frequency variation
- Voltage

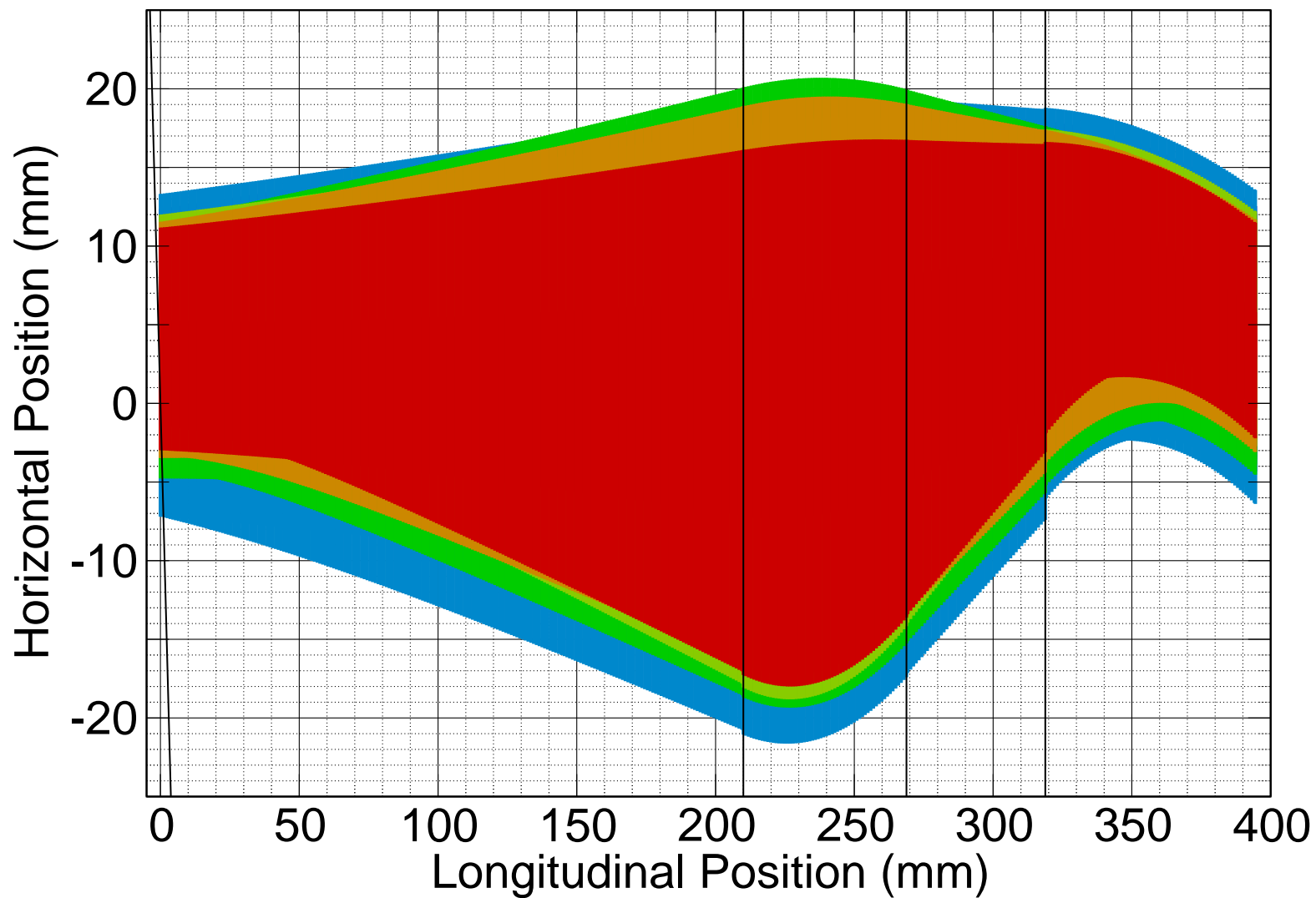
RF Aperture

- Combination of all configurations determines RF aperture
- RF aperture diameter is 34.751
 - ◆ Determined by horizontal beam size
 - ◆ Assumes that center of RF is at 0.439 mm
 - ◆ Assumes that RF is 105 mm long, in center of 210 mm drift
- Maximum aperture determined by distance of end from F magnet
 - ◆ With 110 mm cavity and shift, that end is further from the F magnet
 - ◆ I have not adjusted apertures
- Could make aperture at the D end of the cavity smaller than at the F end

EMMA Geometry



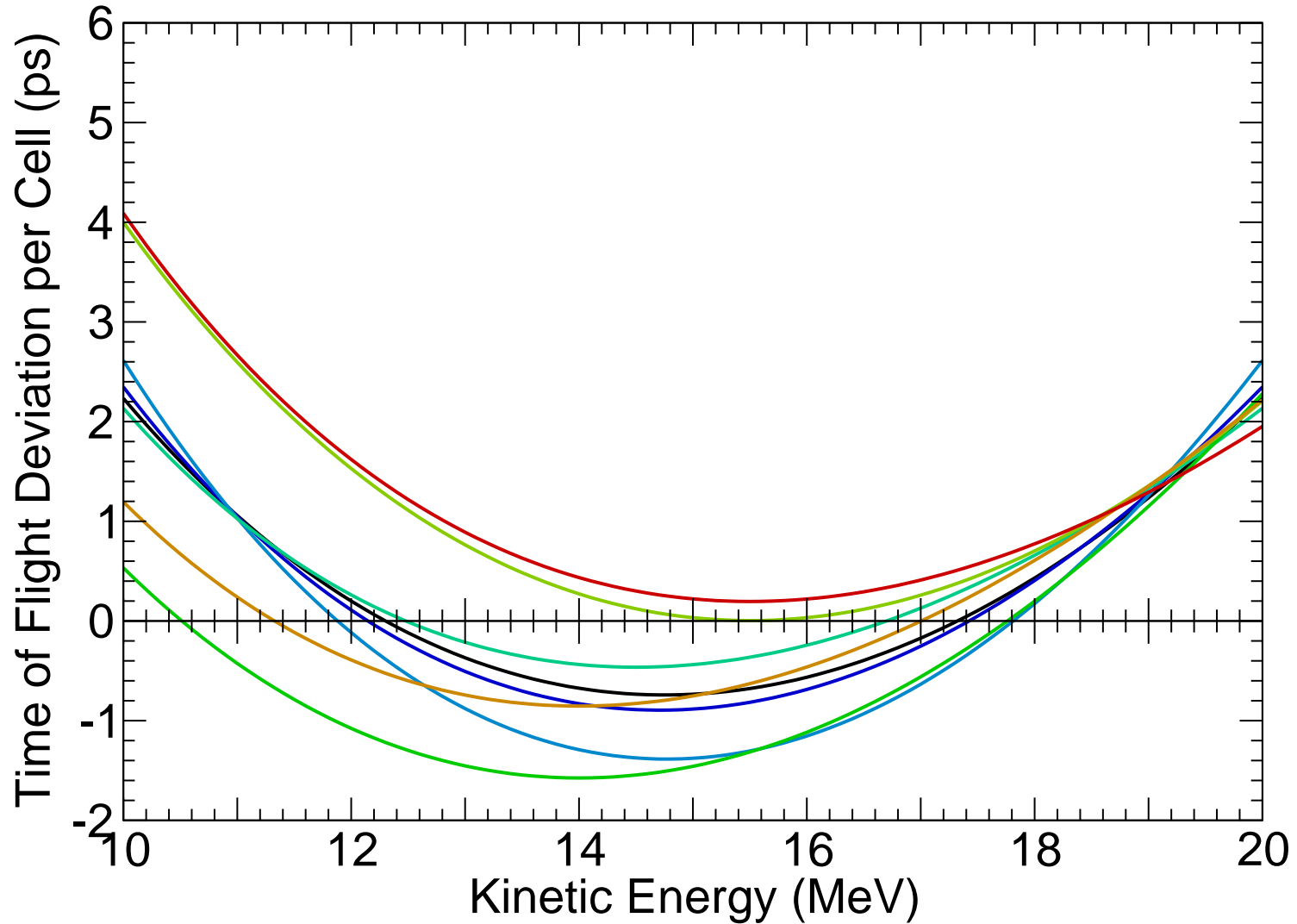
Horizontal Beam Footprint



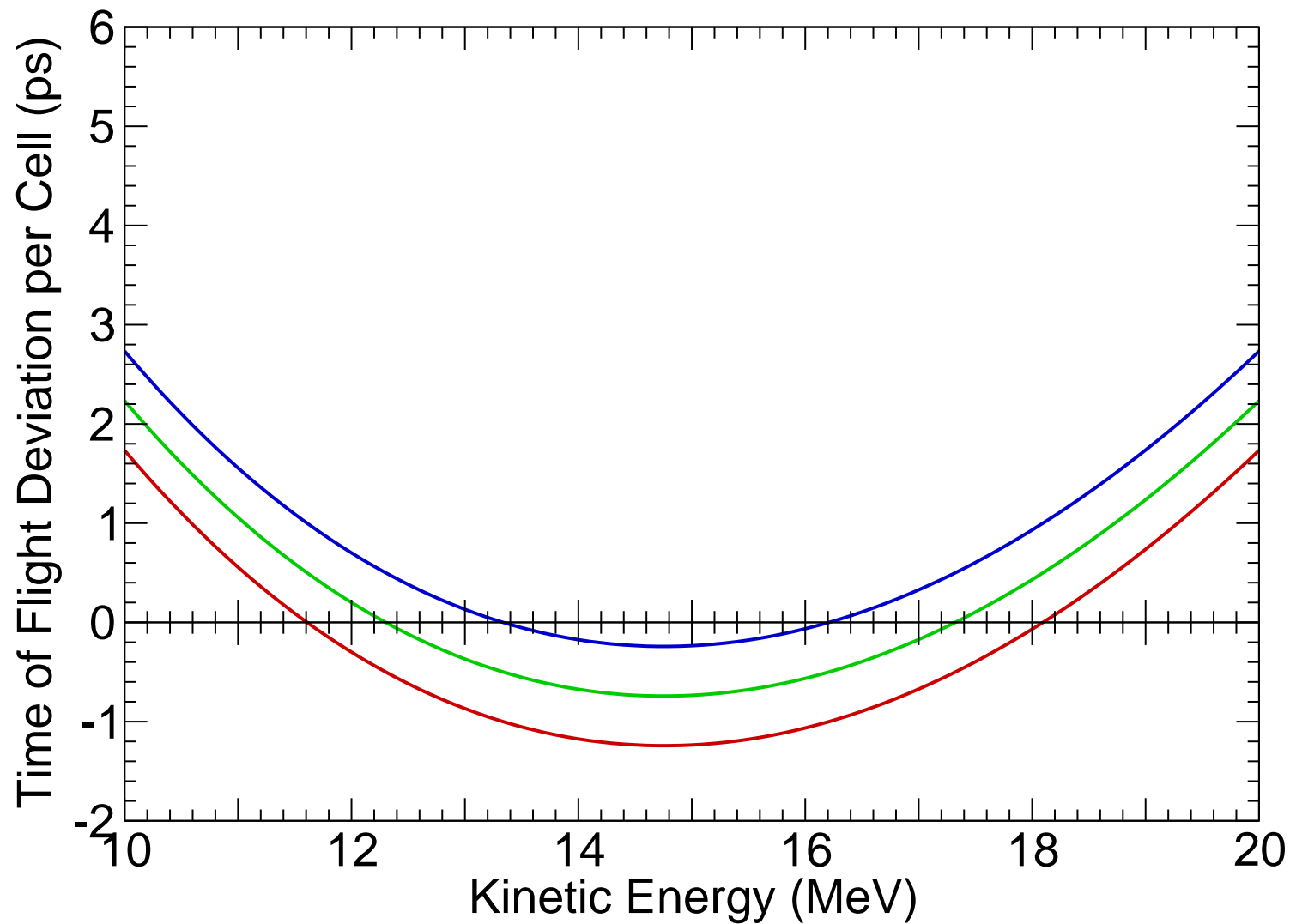
Frequency Variation

- Should be able to synchronize RF to any energy of each configuration
 - ◆ Different configurations will need different RF frequencies to be synchronized to RF
 - ◆ For a given configuration, vary which energies are synchronized to RF (vary b)
 - ◆ For commissioning, synchronize to injection energy
 - ★ Allows us to stay at fixed energy, synchrotron oscillations
- Requires range of -4019 to +1554 kHz from 1.3 GHz RF ($h = 72$)
 - ◆ Asymmetry because baseline is synchronized to 1.3 GHz RF
 - ◆ Changed configuration with time of flight minimum at 16 MeV to have minimum at 15.5 MeV: reduced frequency range
- Have plenty of time to change frequency

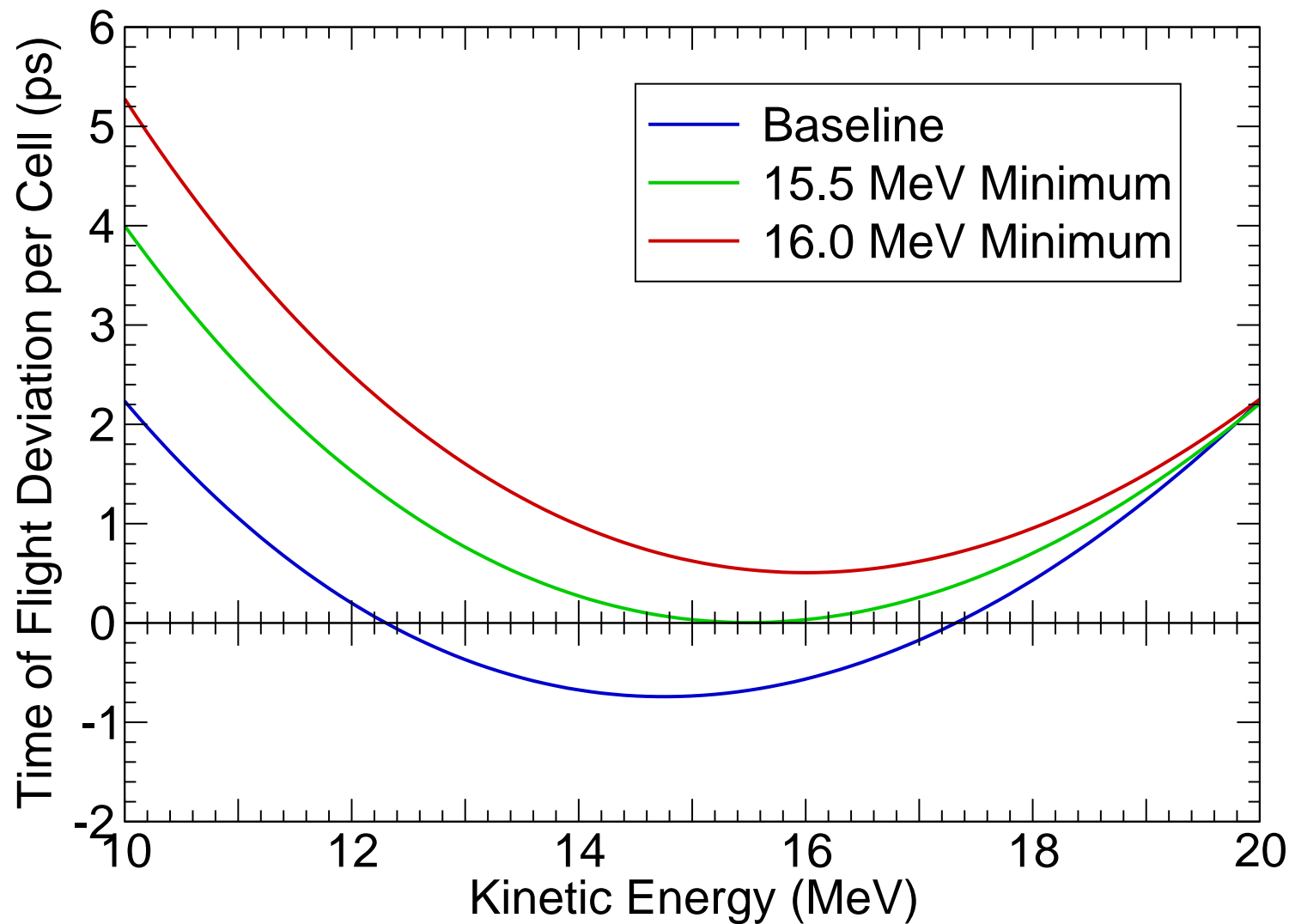
Time of Flight for Different Configurations



Varying b



Lower Energy Minimum in Time of Flight



RF Voltage

- Want to vary a to vary longitudinal phase space
- a proportional to RF voltage
- $a = 1/12$ is baseline, may be challenging to operate below
- $a = 1/6$ to get decent headroom over that to experiment
 - ◆ Need 2286 kV in the ring to achieve this in all symmetric configurations
 - ◆ That's about 120 kV each in 19 cavities
- Would be interesting to explore higher a
 - ◆ Phase space changes character at $a = 1/6$ (symmetric cases)
 - ◆ Explore by going up to $a = 1/4$ (3429 kV, 180 kV/cavity)
 - ◆ Not much interesting above $a = 1/2$ (6858 kV, 361 kV/cavity)
 - ◆ Seems to be “upgrade” at this point
- More voltage would let you explore asymmetric cases more

Longitudinal Phase Space

